

BIOPLASTICS

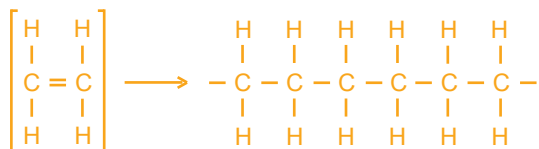
PLASTIC IS AN IMPORTANT PART OF OUR LIVES.

Plastics are **synthetic** (manmade) or naturally occurring substances that can be shaped when soft and then hardened to retain that shape.¹

The strength and design flexibility of plastics make them suitable for use in many industries, including building and construction, electronics, healthcare, computer programming, telecommunications, transportation and even space travel.² Because they are so lightweight, plastics have improved the fuel efficiency of vehicles, which helps save fuel and reduce greenhouse gas emissions.

The structure of plastics

Plastics are **polymers** – large molecules made up of repeating chains of smaller molecules called **monomers**. Conventional plastics are polymers typically made from petroleum-based resources.³ For example, **polyethylene** is formed by combining monomers of ethylene (C_2H_4).



Polyethylene monomer

Polyethylene chain

What are bioplastics?

Bioplastics are plastics made entirely or partly from plant and animal products. They are a promising development that could substitute the crude oil used in plastic production with renewable sources, which are replenished over time.

Some **biobased** polymers (from biological or natural sources) used to make bioplastics come from agricultural sources:

- **Starch** is composed of **glucose** monomers (simple sugars) that are produced by plants as energy. Starch is found in potatoes, corn, wheat and rice.⁶
- **Cellulose** is a substance found in plant cell walls that helps plants stay stiff and strong.⁷ While wood pulp is the main source of cellulose for biobased polymers, it can also be obtained from plants like cotton and hemp.⁸
- **Protein** comes from plants like corn, wheat and soy. It is also found in animal sources, and includes **collagen**,⁹ a protein that provides structure to bones, skin, tendons and ligaments.

Wheat is a source of starch used for making bioplastics.



Snowboards are made from HDPE.

High density polyethylene (HDPE), used for everything from milk containers to snowboards,⁴ consists of dense polymers of polyethylene, resulting in a more rigid plastic. Most shopping bags and plastic films are made from **low density polyethylene (LDPE)**, which is more flexible.⁵



Cotton plant ready to be harvested

The first-ever synthetic plastic, developed in 1862, was a bioplastic made from cellulose.¹⁰ Early “manmade” plastics attempted to replicate materials like rubber, ivory or tortoise shells.¹¹

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THE PROBLEM WITH PLASTICS

Extensive use of petroleum-based plastics poses a serious environmental threat.¹² Although plastics will gradually break down into smaller and smaller pieces, they never completely disappear. In fact, plastics can stay in the environment for up to 1,000 years.¹³ The manufacturing process also creates greenhouse gases like carbon dioxide that contribute to climate change.

Microplastics are tiny pieces of plastic that are less than 5mm in size. They come from **microfibres** (strands of plastic shed from synthetic fabrics), **microbeads** (remnants from products like facial scrubs and body washes), and other larger plastic waste that has broken down. Microplastics have been shown to cause physical harm to people and animals, as well as accumulate in waterways. The use of microbeads in personal care products was banned in Canada in 2018.^{14,15}

Plastic waste picked up off a beach

Benefits of bioplastics

- Bioplastics are made entirely or partly from renewable resources.
- Bioplastics can come from materials leftover from food production, which helps prevent waste
- Some bioplastics are **biodegradable**, meaning they can be decomposed by **microbes** (bacteria, fungi and algae).¹⁶
- Some bioplastic products are **compostable**, meaning microorganisms will quickly break them down in a hot, wet environment.¹⁷
- Biobased polymers can result in equal or superior products to petroleum-based polymers, e.g., bioplastic food wrap.¹⁸

The Verdict is Still Out

Bioplastics are a relatively new technology. Although bioplastics present opportunities as a substitute for crude oil products, they are only a tiny fraction of the plastic produced in the world today. This makes it difficult to measure how much positive impact they are having.¹⁹

There are also other challenges. Not all bio-based plastics are compostable. Those that are often end up in landfills because they can generally only be composted in industrial facilities.²⁰ As well, many recyclable bioplastics aren't yet accepted by recycling facilities.²¹

There's a future in bioplastics!

Researchers in Canada are working with soybeans and canola seed to develop plant protein-based bioplastic for packaging to keep meat, dairy and other food products fresher longer.²² Research is also in progress to produce a biobased and biodegradable polymer, polyhydroxyalkoante (PHA), from oilseeds like Camelina.²³

Soybeans